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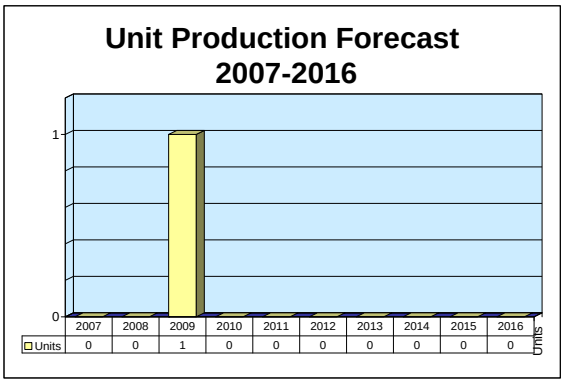
Scorpius - Archived 9/2008

Outlook

- Air Force eliminates funding for Scorpius
- Microcosm ends work on Scorpius program
- Program could be revisited by Air Force if needs for Operationally Responsive Space make it necessary; if so, Scorpius could be ready within two years of such a decision
- If funds are not added during the FY08 U.S. defense budget process, this report will be archived in 2008



Orientation

Description. Scorpius is a program to develop a family of suborbital and orbital launch vehicles.

Sponsor. Privately sponsored by the manufacturer, with funding support from the U.S. Air Force Phillips Laboratory, Missile Defense Agency, and NASA Marshall Space Flight Center.

Status. R&D; the first SR-S suborbital launch took place from the White Sands Missile Range, New Mexico, in January 1999. The SR-XM-2's launch was expected in 2004; however, a lack of funding plagues this program. In September 2006 Microcosm announced that Scorpius development would end due to USAF funding cancellation.

Total Produced. Three

Application. Scorpius rockets have many applications, depending on size. Small sounding rockets would conduct microgravity research, while heavy-lift versions initially would carry up to 6,800 kilograms to LEO.

Price Range. SR-S suborbital rocket, $127,000; SR-M suborbital rocket, $335,000; Sprite Mini-Lift, $4.6 million; Liberty Light-lift, $6.8 million; Exodus Medium-Lift, $12.6 million.

Contractors

Prime

Microcosm Inc	http://www.smad.com, 401 Coral Circle, El Segundo, CA 90245-4622 United States, Tel: + 1 (310) 726-4100, Fax: + 1 (310) 726-4110, Email: jwertz@smad.com, Prime

Subcontractor

Northrop Grumman Corp	http://www.northropgrumman.com, 1840 Century Park E, Los Angeles, CA 90067-2199 United States, Tel: + 1 (310) 553-6262, Fax: + 1 (310) 201-3023, Email: onewebmaster@ngc.com (Engine Injectors)

Scorpius

Rockwell Collins Inc	http://www.rockwellcollins.com, 400 Collins Rd NE, Cedar Rapids, IA 52498-0001 United States, Tel: + 1 (319) 295-1000, Fax: + 1 (319) 295-5429, Email: collins@rockwellcollins.com (Navigation Equipment)
Schafer Corp	http://www.schafercorp.com, 309 Renard Pl SE, Suite 300, Albuquerque, NM 87106 United States (Engine Co-development)
Southwest Research Institute	http://www.swri.org/, 6220 Culebra Rd, PO Drawer 28510, San Antonio, TX 78228-0510 United States, Tel: + 1 (210) 648-5111 (Flight Computer)
U.S. Air Force Research Laboratory	http://www.afrl.af.mil/, 1864 4th St, Wright-Patterson AF Base, OH 45433-7132 United States, Tel: + 1 (937) 656-9876, Email: afrl.pa.dl.all@wpafb.af.mil (Engine Co-development)

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Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Design Features. The main design feature of the Scorpius family of launch vehicles is simplicity – from the propulsion system to guidance control to structure material. Although the rocket requires modern advances in low-cost computer technology and low-cost, high-strength composite material, the developer maintains that the low recurring cost is a result of designing the vehicle to be manufactured (not built and then assembled) by engineers. Much as Henry Ford used assembly line techniques to keep down the cost of the Model T, the Scorpius family approach extends to all parts of the process: development, manufacturing, test, facilities, and operations. For example, no launch gantry or service tower is required to service the payload.

Costs for testing components are also kept to a minimum. For example, two engines were fabricated and test-fired for less than $30,000. Scorpius engines producing 22.2 kN of thrust cost less than $5,000 each, allowing several engines to be built and test-fired or even destroyed to find failure mechanisms.

Scorpius avionics use a low-cost flight computer and pod electronics module developed by Southwest Research Institute. Both the computer and pod electronics are offered for about $4,000.

The baseline Scorpius launch vehicle features a core structure surrounded by multiple, identical pods for all but the final stage. The Sprite vehicle, for example, is composed of six 1.06-meter-diameter booster pods and a single sustainer pod. Depending on the configuration, a Scorpius vehicle can employ up to 49 engines in seven clusters or pods and three or four stages.

Unlike the Space Shuttle and liquid-propellant-fed expendable launch vehicles, the Scorpius family of boosters uses no high-pressure tanks or turbo pumps or complex machinery. The engine design features a pressure-fed system using a proprietary mixing gas generator, which is both inexpensive and environmentally safe. Microcosm claims that it is the mixing gas generator that allows the vehicle to be scaled to medium- and heavy-lift launch vehicles. Scorpius engines burn RP-1 (kerosene) and liquid oxygen and feature ablatively cooled nozzles.

Vehicle	Vehicle Length	Payload	Configuration	Engine
SR-S	9.4 m/31 ft	45.3 kg/100 lb to 240 km/130 nm	Single stage, three rear fins	Single Scorpius, 22.2 kN/5,000 lbst
SR-XM-1	11.5 m/38 ft	TBD	Single stage, three rear fins	Dual Scorpius, 22.2 kN/20,000 lbst
SR-XM-2	11.5 m/38 ft	272.7 kg/600 lb to 199 km/108 nm	Single stage, three rear fins	Single Scorpius, 88.9 kN/20,000 lbst
SR-M	TBD	TBD	Single stage, three rear fins	Single Scorpius, 88.9 kN/20,000 lbst

Vehicle	Vehicle Length	Payload	Configuration	Engine
SR-2	16.1 m/53 ft	TBD	Core sustainer pod with six booster pods, three rear fins	Single Scorpius, 88.9 kN/20,000 lbst thrust for sustainer stage and six 88.9-kN thrust engines for booster pods
Sprite	14.4 m/47.3 ft	472.5 kg/1,050 lb to 185 km/100 nm	Core sustainer pod with six booster pods, one upper stage	Single Scorpius, 88.9 kN/20,000 lbst for sustainer stage, six 88.9-kN thrust engines for booster pods and 11.1 kN/2,500 lbst upper stage
Antares	16.1m/53 ft	TBD	Core sustainer pod and two booster pods, six rear fins; two-stage version of SR-M with Sprite upper stage	Single Scorpius, 88.9 kN/20,000 lbst for sustainer stage and two 88.9-kN thrust engines for booster pods
Exodus	26.8 m/88 ft	6,804 kg/15,000 lb	Core sustainer pod and six booster pods, six rear fins; four stages with optional upper stage	Twenty-two 355.8 kN/80,000 lbst engines, plus 21 88.9-kN thrust engines
Space Freighter	26.8 m/88 ft	TBD	Core sustainer pod and six booster pods, six rear fins; two-stage version of SR-M with Sprite upper stage	Single Scorpius 88.9 kN/20,000 lbst and six 88.9-kN engines for booster pods

Source: Microcosm Inc

Variants/Upgrades

SR-S. Sounding rocket
SR-XM-1. Sounding rocket
SR-XM-2. Sounding rocket
SR-M. Sounding rocket
SR-2. Small launch vehicle
Sprite Mini-Lift. Small launch vehicle
Antares Intermediate-Lift. For payloads to LEO
Exodus Medium-Lift. For payloads to LEO
Space Freighter. Large payloads to LEO

Program Review

Background. The Scorpius concept got its start in the 1980s when Edward Keith, now Microcosm's principal launch system engineer, broached an idea for a launch system with a dramatically lower cost. Seven Air Force Phillips Laboratory contracts later, the program moved to a Phase I Small Business Innovative Research system study in 1993.

Although the Phase I study was designed to address systems issues regarding a reduced-cost vehicle, engine hardware development during this time resulted in a 22.2-kN engine costing only $5,000 and built in just three weeks. The first test engine was successfully fired on a private test range near San Jose, California, in 1993.

First SR-S Launch Attempt Fails

Microcosm's first attempt at launching the SR-S suborbital vehicle in 1998 failed when a fuel line failed to deliver liquid oxygen to the rocket's engine. The launch attempt took place at the White Sands Missile Test Range, New Mexico.

During the test, kerosene did flow for a brief period and ignited, causing damage to the lower portion of the vehicle. The vehicle was returned to the Microcosm facility in Torrance, California, for refurbishment and further ground testing, and was successfully launched in early 1999.

SR-XM Launch Success. The SR-XM sounding rocket was launched in March 2001 from White Sands Missile Range, New Mexico. The rocket carried a small thruster payload developed by TRW (now Northrop

Scorpius

Grumman) and DARPA, and is the first of a new liquid booster family as well as the successor of the smaller SR-S launched in January 1999.

SR-XM-2. Microcosm began development of a larger 20,000-lbst engine for testing at the Energetic Materials Research Test Center (EMRTC) Rocket Test Site in Socorro, New Mexico. This powerplant was to be installed in the SR-XM-2 vehicle that was slated to make its first launch in July 2004.

Sprite Tank Tested

In the summer of 2006, Microcosm completed final qualification tests on the full-scale, all-composite cryogenic liquid oxygen (LOX) tank for the Sprite Small Launch Vehicle. In testing done for the Scorpius Space Launch Company (SSLC), Microcosm successfully tested a 42-inch-diameter, all-composite LOX tank to nearly four times its operating pressure of 550 psi.

Funding

Funding for the Scorpius program was provided by Microcosm, the United States Air Force, the Missile Defense Agency, and NASA's Marshall Space Flight Center.

Timetable

Month	Year	Major Development
Dec	1993	Scorpius engine successfully fired
Sep	1998	SR-S launch attempt fails
Jan	1999	SR-S launch attempt successful
Mar	2001	SR-XM launch attempt successful
	2006	USAF terminates Sprite funding

Forecast Rationale

Scorpius, the program that triggered much of the current buzz surrounding Operationally Responsive Space (ORS), is scheduled to come to an end. Microcosm must cease Scorpius operations because the U.S. Air Force has ended funding for the project. Microcosm will be forced to reduce the number of personnel that have been working on this low-cost launch vehicle program at its El Segundo facility.

The Air Force contract that Microcosm was working under was subject to funding limitations within the Department of Defense budget, and these ever-changing levels forced adjustments to the USAF schedule and ultimately to the Scorpius business case. As we said in last year's report, the only thing standing in the way of Scorpius was unstable funding, a rather significant hurdle.

According to Microcosm President Dr. James Wertz, "Scorpius is the only existing launch vehicle program that I am aware of which can put 1,000 pounds into low-Earth orbit for less than $5 million in realistic quantities. It can fly through 99.9 percent of winds aloft, lift off in 100-knot winds, launch within eight hours of an unanticipated demand and within two hours if on alert on the pad, and can be scaled directly to medium- and heavy-lift vehicles. Unlike most defense programs, the Scorpius performance keeps getting better as the design matures while costs have remained the same or come down somewhat."

Wertz further stated, "We strongly believe that the country needs dramatically lower cost, responsive launch vehicles for both military and civilian applications. Nonetheless, we are a small business and don't have the resources to develop a launch vehicle without the government."

Dr. Wertz's last statement summed up the future of Scorpius . without an influx of cash from the Pentagon, the program is headed for the engineering archives instead of the launch pad. Forecast International, however, is still issuing a forecast for just one Sprite vehicle to meet possible TacSat launch needs. However, if no funding is added to the project during the FY08 defense budget process, then this program will be archived in 2008.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	**High Confidence**					**Good Confidence**			**Speculative**			
	Thru 2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
Microcosm Inc												
Scorpius - Sprite												
	0	0	0	1	0	0	0	0	0	0	0	1
Total	0	0	0	1	0	0	0	0	0	0	0	1